ACCESSION #: 9705010237
LICENSEE EVENT REPORT (LER)

FACILITY NAME: James A. FitzPatrick Nuclear Power Plant PAGE: 1 OF 11

DOCKET NUMBER: 05000333

TITLE: Plant Shutdown Due to Human Error Inadvertently Connecting Two Terminals While Calibrating Protective Relay
EVENT DATE: 09/16/96 LER #: 96-010-01 REPORT DATE: 04/22/97

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On 9/16/96, with the plant operating at 100% power, the UPS M-G set removed from service for maintenance and protective relay calibration in progress, the screwdriver a technician was using slipped and inadvertently connected two terminals of a 24KV iso-phase bus ground fault protective relay. This relay is in service when back-feeding plant loads from the 345 KV line. The short circuit simulated relay contact closure and caused the Main Unit Output Transformer load side circuit breakers to open which resulted in a generator load reject from 100% power. The short circuit also inhibited (by design) the fast transfer of station loads to their reserve power source. The subsequent residual transfer resulted in a loss of circulating water flow and subsequent loss of condenser vacuum. Condenser pressurization resulted in actuation of rupture disks on a LP Turbine Hood and one of the RFPT exhaust manifolds. An Unusual Event was declared based on indication of main turbine seal failure. RPV level and pressure were controlled using HPCI, RCIC and

SRVs. The EDGs started as designed but were not required to supply electrical loads.

END OF ABSTRACT

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EVENT DESCRIPTION

The plant was operating at 100% power with reactor pressure vessel (RPV) [AD) water level being automatically maintained at the normal level of approximately 202 inches above the top of active fuel (TAF). The Uninterruptable Power Supply (UPS) Motor-Generator Set (AD] was out of service to repair a failed bearing and the UPS bus [EF) was being supplied from a safety related alternate feed [EJ].

While reinstalling a 24KV iso-phase bus [EL] ground fault protective relay, a screwdriver being used by one of the technicians to reinstall a capacitor on the back of the relay housing, slipped and inadvertently connected two terminals of the 24KV iso-phase bus ground fault protective relay. This relay is in service when backfeeding plant loads from the 345 KV line [EL]. The relay was not in service when this occurred at 13:04 on September 16, 1996.

This action simulated contact closure and resulted in the energization of protective relays which energized system fault relays which sent direct signals to trip the outgoing 345KV power circuit breakers (10042 and 10052) [EL] and sent a signal to an open permissive in the motor operated disconnect switch [EL] on the output of the Main Unit Transformer (T1 A/B) [EL). The protective relay sequence also initiated signals to trip the main turbine (TA] and the main generator exciter [TL], and block the fast transfer of station electrical loads to the reserve transformers (T2 & T3)[FK].

The opening of the outgoing 345 KV power circuit breakers disconnected the turbine-generator [TB] from the power grid and initiated a protective sequence to quickly dump Electro-Hydraulic (EHC) fluid pressure to close the turbine control valves [TG] to protect the main turbine [TA] from overspeed. At the same time, a signal was sent to open the turbine bypass valves [JI] to allow the steam to exhaust into the main condenser [SG].

A reactor scram signal was initiated by sensing the dumping of the EHC pressure to the turbine control valves [JI].

The actuation of the 24KV iso-phase bus ground fault protective relay inhibited (by design) an automatic fast transfer of station 4KV electrical buses [EA] to the 115KV:4KV reserve station transformers (T2 & T3)[FK].

An automatic residual transfer occurred and the 4KV electrical buses (10300[EA], 10400[EA], 10500(EA], and 10600[EA)) were re-energized from the reserve power source. As a result of the residual transfer, all 4KV loads including condensate[SD] and condensate booster pumps[SG), circulating water pumps [SG] and normal service water pumps [KG] were automatically tripped off within seconds of the initial turbine trip due to the undervoltage condition on the 4KV buses. Many plant 600V or lower loads [EC] including service air compressors [LF] and turbine building (NM] ventilation systems were de-energized as well. Loads were manually restored later by operator actions.

When undervoltage on the two emergency 4KV buses (10500 and 10600) was sensed, the four Emergency Diesel Generators (EDGs) [EK] started as designed. Before the EDGs reached rated speed and voltage, the residual transfer had restored power to the two emergency buses, therefore, the generator output breakers did not close on the two emergency buses (10500 & 10600).

The reactor scram, initiated by the Turbine Control Valve Fast Closure signal, was successful. Due to the loss of the alternate feed to the UPS and the residual bus transfer, power was lost to the Rod Position Information System [JL]. The operators verified the reactor was shutdown using Average Power Range Monitor (APRM) [IG] power downscale indications and by locally verifying all scram valves to be open. Operators completed this verification at 1333. All control rods [AA] were later verified to be fully inserted after power was restored to the UPS and RPIS systems. Operators completed this verification at 1421.

The generator trip caused the control valves to close rapidly and the bypass valves to open. Reactor pressure initially increased rapidly to a maximum of 1082 psig three seconds after the trip. "G" Safety Relief Valve (SRV) [SB] opened at this peak pressure and remained open for approximately five seconds. Reactor water level decreased as a result of the scram and because both Turbine Driven Reactor Feed Pumps [SJ] tripped on low suction pressure due to the loss of all condensate and condensate booster pumps.

Reactor water level reached its lowest recorded level of 125.4 inches at

17 seconds after the reactor scram. High Pressure Coolant Injection (HPCI) [BJ] and Reactor Core Isolation Cooling (RCIC) [BN] automatically initiated. A Group II Primary Containment Isolation [JM] occurred as required at an RPV level of 177 inches above the top of active fuel. RPV level was restored using HPCI and RCIC pumps. RPV level was subsequently maintained with RCIC.

Turbine bypass valves stayed open for approximately 29 seconds following the reactor scram to initially control RPV pressure until RPV pressure lowered to approximately 916 psig. At this point in the event, the Main Steam Isolation Valves (MSIV) remained open as no isolation signal was present. With the initial loss of the non-safety related electrical buses, the circulating water pumps were de-energized causing a loss of condenser vacuum. Shortly after the reactor scram, operators lowered the EHC pressure setpoint to verify automatic pressure control.

Following the scram, the operators attempted to verify that all control rods [AA] had inserted and noted that there were no indications or lights for any parameters on the control room full core display [IU]. The operating crew mistakenly diagnosed the absence of functioning indication on the control room full core display as an indication that the Reactor Protection System (RPS) [JA] bus had been de-energized. The Shift Manager directed a licensed operator to transfer the two RPS buses to alternate power supplies in order to re-energize RPS.

The operator believed that power was not available from the RPS MG Sets. The operator believed that transferring to the alternate power supplies, which he thought were available, would restore power to RPS. The RPS buses were, in fact, energized from the RPS MG Sets. The Alternate power supplies he had been directed to transfer RPS to were not energized. About 8 minutes into the transient (at 1312), RPS was transferred to de-energized sources initiating a Group I primary containment isolation (MSIVs closed). Condenser vacuum had decreased to approximately 9 inches of mercury just prior to MSIV closure. The RPS buses were restored 10 and 14 minutes later when the condition was identified.

Condenser inlet waterbox (circulating water) temperature reached a maximum of approximately 225 degrees F. Condenser vacuum decreased until local pressures reached a point at which one of the four rupture disks on the "B" low pressure turbine ruptured. This rupture disk is designed to rupture at approximately 5 psig. A rupture disk on the Reactor Feed Pump Turbine "B" exhaust also ruptured. This rupture disk is also designed to rupture at approximately 5 psig.

The residual thermal energy in the secondary plant system piping combined with the thermal energy added via the turbine bypass valves provided sufficient energy to pressurize the condenser and actuate rupture disks on the "B" LP turbine hood and RFPT exhaust hood.

The post transient review determined that the LP turbine hood rupture disk ruptured as designed, at 5 psig. Post transient evaluation of the RFPT rupture disk found the disk was corroded and was most likely perforated prior to the event.

The steam inventory in the main steam lines [SB] (downstream of the MSIVs) and in the secondary systems was relieved to the turbine building [NM] atmosphere. Steam was observed leaking from the turbine building. Environmental samples taken during the event recovery indicate that the release levels were less than detectable for all plant related radionuclides.

The alternate feed breaker to the UPS distribution system also tripped on undervoltage during the residual transfer. This alternate feed breaker does not automatically reclose and there was a loss of UPS loads including the public address system [FI], Feedwater Control [JB], and various Control Room Indications [IU] concurrent with the turbine trip. The absence of the plant public address system presented a challenge to the operating crew in communicating and coordinating their transient response and recovery. Security personnel, with radios, made themselves available to mitigate the communications problems.

Operators unsuccessfully attempted to restore the UPS distribution panel within 15 minutes of the plant trip. Electrical maintenance personnel were called for assistance and the alternate power breaker was manually reset and closed, re-energizing the UPS distribution panel one hour and thirteen minutes after the reactor scram.

Entry into Emergency Operating Procedure (EOP-4), Primary Containment Control, was required due to increased suppression pool (torus) temperature [IM] as a result of operating SRVs and the HPCI and RCIC systems during the transient. EOP-4 directs the use of all available torus cooling to maintain torus temperature below 95 degrees F. When attempting to start the "D" Residual Heat Removal (RHR) [BO] pump from the control room (in torus cooling), the pump circuit breaker failed to close. RHR pumps "A", "B" and "C" were started and provided torus cooling. During corrective maintenance, the "D" RHR pump circuit breaker did close when operated from control room. The "D" RHR pump was placed in service at 1658 on September 16, 1996.

At 1340, a Notification of Unusual Event was declared based on indication of main turbine seal failure. The Technical Support Center (TSC) and Operational Support Center (OSC) of the Emergency Response Organization were activated. RECS notification was made at 1353 and an ENS notification was made at 1416.

Electrical power was restored to the non-vital buses in accordance with AOP-57 (Recovery from Residual Transfer). Upon restoration of the non-vital buses, all three Transverse Incore Probe (TIP) [IG] primary containment isolation ball valves were discovered open prior to reset of the Group II isolation due to failure of a non-safety-related 24 VDC power supply providing an erroneous TIP probe position signal to the TIP system control computer. The TIP ball valves were manually closed.

Restoration of loads fed from the non-vital buses in accordance with AOP-57 allowed restoration of plant air systems, ventilation, condensate pumps and other plant service loads. EDGs were secured at 1351 (47 minutes after the trip). Operators energized the 10100 and 10200 buses at 1705 and a circulating water pump was placed into service at 2016.

After the LP turbine rupture disk was repaired, the condenser was returned to service. The site exited the Emergency Plan after confirming the use of the main condenser as a heat sink at 0236 on September 17, 1996. Normal shutdown cooling was established at 0544 and the reactor was in a cold condition at 0600.

CAUSE OF EVENT

The event was initiated by human error while reinstalling a 24KV iso-phase bus ground fault protective relay.

The work was performed in accordance with a planned work package. The work package was inadequate in that it did not identify the risk to the plant inherent in this evolution. In preparing the work package, an adequate walk down was not performed. The planner did not properly evaluate and identify the risk associated with this task.

The assessment and decision to perform the work was based on knowledge that the relay was not in service and only functioned during backfeed in plant outages.

The personnel performing this evolution recognized the risk inherent to the plant but did not question the adequacy of the work plan. Had the personnel performing the evolution challenged the adequacy of the work plan, the work would have either been rescheduled during a plant outage or the work package would have been revised to specify precautions to be taken when working in close proximity to these energized relay terminals.

The cause of this event was a work practice deficiency, an inadequate process for identifying and mitigating plant risk when planning plant work and the lack of a questioning attitude in performing a high risk evolution.

ANALYSIS

This event is bounded by the Generator Load Rejection Without Bypass as described in the James A. FitzPatrick Updated Final Safety Analysis Report (UFSAR).

Plant safety systems responded as expected to this event with exceptions as noted below:

1. All three TIP ball valves opened in the presence of a valid Group II primary containment isolation signal.

2. "D" RHR pump circuit breaker failed to close from a signal from the control room switch.

The operating shift responded to the event as expected with the following exceptions:

1. The operating crew mistakenly diagnosed the lack of indication (no lights) on the full core display as an indication that the RPS bus was de-energized.

2. In preparing to transfer the RPS bus to the alternate supply, the operator failed to recognize that the RPS bus was energized from its normal power source and that the power source he had been directed to transfer the bus to was not energized.

Gamma spectral analysis of environmental samples (both charcoal and particulate filters) taken during the event recovery indicate that the release levels were less than detectable (
radionuclides.

CORRECTIVE ACTIONS

1. The procedures which govern the work control, work package planning and the rolling work schedule have been revised (as applicable) to:

a. Strengthen the process for identifying plant work with the potential to have an impact on plant operations.

b. Exclude risk significant work from the minor maintenance process.

(COMPLETE)

2. The personnel responsible for the initiating event have been counseled with respect to their performance and management expectations regarding the need for pre-job walkdowns of work packages and the need to maintain a questioning attitude, and precautions to be taken when working on energized circuits.

(COMPLETE)

3. Prior to plant restart, a training session was conducted for the Instrument and Controls department to review lessons learned from this event. The session addressed management expectations regarding the need for pre-job walkdowns of work packages, the need to maintain a questioning attitude, and precautions to be taken when working on energized circuits.

(COMPLETE)

4. A training package was prepared and presented to the plant staff prior to plant restart from this event. This package outlined the basic causes of this event as well as provided a brief outline of the operational significance of the event. The purpose of this package was to reinforce management's expectations regarding the need to identify risk in day to day plant activities and stress to plant staff members, at all levels, that they are expected to intervene when risk is identified.

(COMPLETE)

5. The Loss of UPS Abnormal Operating Procedure (AOP-21) has been revised to strengthen the guidance for manual operation of the UPS alternate feeder breaker. An operator aid has been developed and training conducted on the procedure change and the operator aid. Prior to restart, all operating shifts were trained on the power

supply configuration for the full core display.

(COMPLETE)

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6. A comprehensive assessment of plant systems challenged by this plant transient was conducted to ensure readiness for restart. This assessment included an evaluation of potentially effected Environmentally Qualified equipment in the turbine building, turbine/generator performance as well as a walkdown of the following plant equipment/systems:

a. Main Condenser

b. Turbine Building Structure, Roof and Fire Dampers

c. Main Turbine and Reactor Feedpump Turbine Rupture Disks

d. HPCI and RCIC Systems

e. Reactor and Turbine Building Instrument Air System

f. Moisture Separator Reheat System and Drains (including extraction steam lines)

g. Turbine Lube Oil

h. Feedwater Heater Drains

i. Condenser Air Removal and Offgas System

j. Turbine Building Electrical System and Cables in Effected Areas

k. Reactor Feed Pump Rooms

(COMPLETE)

7. Operating procedures for Reactor Scram and Loss of Condenser Vacuum have been revised to ensure the MSIVs are closed before condenser vacuum lowers to 8 inches of mercury.

(COMPLETE)

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8. An equipment failure evaluation (EFE) was performed on the failure of the "D" RHR pump circuit breaker to close. The EFE concluded that switch contacts within the circuit breaker closure mechanism intermittently failed to make contact at a consistent contact point due to some looseness in one of the switch's stationary contacts. This caused intermittent failure of the close coil to energize when the switch exhibited sufficiently high contact resistance. Engineering evaluation has determined that these contacts can be electrically bypassed (jumpered out) and a modification was performed to electrically bypass these contacts. This modification was performed on all safety related 4KV circuit breakers which require automatic or manual closure to perform their intended accident mitigation function.

(COMPLETE)

9. Additional radios have been purchased for use by plant operators.

(COMPLETE)

10. An engineering evaluation is being conducted to determine the acceptability of restarting circulating water pumps immediately following a residual bus transfer.

(COMPLETE)

11. All rupture disks on the Main Turbine and Reactor Feed Pump Turbines have been replaced. The preventive maintenance program will be updated to put rupture disks on the Main Turbine and Reactor Feed Pump Turbines on a six year replacement interval to coincide with the applicable major equipment inspections.

(COMPLETE)

12. The transient response of plant systems is undergoing detailed analysis to verify design adequacy. A preliminary evaluation will be completed by December 1, 1996.

(COMPLETE)

13. The adequacy and basis for the TIP control system is undergoing engineering review.

(COMPLETE)

14. Supplementary communication systems will be evaluated for use by plant operators in the event normal communication systems are not functioning.

(This action will be completed by July 19, 1997)

15. A significant component of the cause of this event was due to human performance deficiencies. In order to determine the cause of these deficiencies, a human performance evaluation team was assembled to evaluate behavioral characteristics which may have contributed to this event, as well as other instances of human error at FitzPatrick. This team has documented their evaluation and has presented it to plant management. The results of the evaluation and recommended corrective actions are being presented to the plant staff in formal training sessions. Corrective action recommendations made by this team are scheduled for implementation and are being tracked by the plant Action Commitment Tracking System.

ADDITIONAL INFORMATION

A. Failed Component

Component ID: 71-10640 (52 SMLS Contact 5-6)
System: Electrical Distribution (RHR Pump Circuit Breaker)
Manufacturer: General Electric
Model Number: CR 294 OU301
NPRDS Manufacturer Code: G082

Component ID: 07 TIP-108
System: Neutron Monitoring (Transverse Incore Probe, 24 VDC Power Supply)
Manufacturer: Zentro Electric GMBHKG
Model Number: GTN-300-24
NPRDS Manufacturer Code: Not Applicable

B. Similar Events

None

*** END OF DOCUMENT ***